

## A SURVEY ON COMPUTER AUTOMATED TRADING IN INDIAN STOCK MARKETS

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### ABSTRACT

*In India day by day increasing investors attitude to invest amount in stock markets due to increasingly use of automated systems, social network analysis, predictive analysis, data mining tools and machine learning. In this paper we provide an overview of the secrecy and complexity of the algorithms and how the automated trading systems will work.*

**KEYWORDS:** Algorithmic Trading, Electronic Trading, Market Micro Structure, Trading Process & Fundamental Analysis

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### INTRODUCTION

Algorithm is defined as a step by step procedure to solve a particular task or process. Algorithm is the process of using computer programs to follow a defined set of instructions for placing a trade in order to generate profits at as speed and frequency that is impossible for a human trader. The defined sets of rules are based on timing, price, quantity or any mathematical model.

Algorithm systems seek to capture momentary inconsistency in share prices, traders emotions, statistical patterns and exploit rivals strategies. The main goal of algorithmic trading system is to reduce the cost savings, clients commissions and obtained profits from vast data. At present hedge fund managers, mutual funds managers, pension fund managers, and institutional traders increasingly deploy the algo trading systems are automated trading or algorithmic trading systems. Algo trading systems presently handle approximately 10 to 30 percentages of all shares or stocks traded in the NSE and BSE. High-frequency algorithmic trading accounted for 30 percent of NSE equity volumes in 2017 and it is a major driver for computing and analytics innovation, especially machine learning computing.

However, algorithmic trading is also of major concern to regulators, as the 6 May 2010 Flash Crash clearly illustrated. In this instance, the NSE Average plunged about 600 points in 30 minutes, causing a loss of billions in the market value of NSE stocks. The crash is occur due to lack of knowledge about algorithmic trading so we need more in depth knowledge is required for avoiding crashes.

### MARKET MICRO STRUCTURE

In this section we are going to explore the different types of trading and how a trade is executed in an exchange, and focus on challenges and objectives.

## TRADE EXECUTION

Dealers generally execute their orders through a shared centralized order book that lists the buy and sell orders for a specific security ranked by price and order arrival time, to execute orders the centralized system uses FIFO algorithm which is a popular algorithm in computer system operating systems. Centralized order-driven trading system continuously tries to match buy and sell orders.

## ELECTRONIC TRADING

Within algorithmic trading, several closely related terms are used that are often confused. These include electronic trading, order-management systems, automated trading, systematic trading, and algorithmic trading. Comprehensively, Electronic exchanging is a technique for trading stocks, derivatives, securities, bonds, foreign trade and (future and options and so on). Inside electronic exchanging, particular programs bring purchasers and dealers through electronic media to make a trade (such as Sensex and Nifty).

An Order-management systems (OMS) is an electronic framework created to execute securities arrangements in a productive and financially savvy way. Brokers and dealers utilize OMSs when filling orders for different sorts of securities and can track the advance of each order all through the framework.

Automated trading systems can be designed to trade stocks, options, futures and foreign exchange products in view of a predefined set of conditions which decide when to enter an order, when to exit a position and how much money to invest in each trading strategy. Trading strategies differ; some are intended to pick market tops and bottoms, others to follow a trend, and others include complex strategies including randomizing orders to make them less visible in the marketplace. ATSS allow a trader to execute orders much quicker and manage their portfolio easily by automatically generating protective precautions.

Advantages of automated trading systems are minimizing emotions, Ability to Backtest, Preserve Discipline, Achieve Consistency, Improved Order Entry Speed, and Diversify Trading.

Disadvantages of automated trading systems are Mechanical failures, Monitoring, and Over-optimization.

The recognizing highlight of algorithmic (referred to by some people as systematic) trading systems is the modernity of their analysis and decision making. Algorithmic trading involves the use of mainframe computer programmes and complex algorithms to make and decide trading strategies for good returns. Institutional managers, fund managers, and investors use algorithmic trading because they buy and sell large amount of shares on every stock market working day. Black-box trading also referred as automated trading, algorithmic trading, and simply algo-trading.

Broadly, these systems are deployed for highly liquid markets and high-frequency trading, such as equities, futures, derivatives, bonds, and foreign exchange (currencies). The essential characteristic of a highly liquid market is that there are ready and willing buyers and sellers at all times.

Many global financial markets trading platforms used the FIX protocol for buying and selling the shares of the firms. FIX protocol is a non-proprietary, free and open standard is constantly developed, and is used by thousands of firms every day to complete millions of transactions. There are various extensions to FIX, including FIXatdl, the FIX algorithmic trading definition language.

Order Book – ABC Inc.			
Buy		Sell	
Quantity	Price	Price	Quantity
5,000	99	99	4,000
8,000	98	100	10,000
10,000	97	101	1,000
15,000	95	103	15,000

(a)

Order Book – ABC Inc.			
Buy		Sell	
Quantity	Price	Price	Quantity
1,000	99	100	10,000
8,000	98	101	1,000
10,000	97	103	15,000
15,000	95	104	3,000

(b)

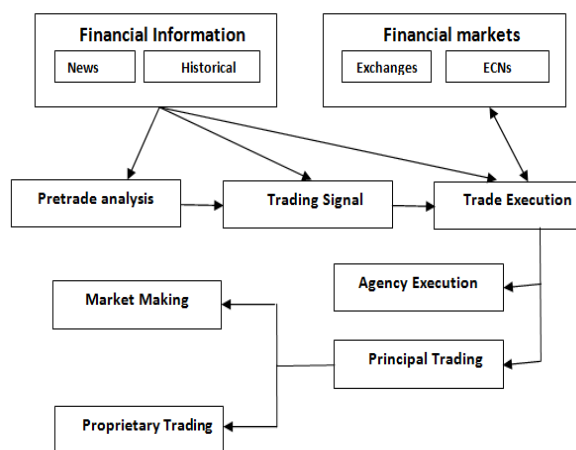
**Figure 1: An Example Trade Order Book**  
 (a) Before Matching a Trade and (b) After Matching a Trade. Buy Orders, which Generally Listed by Price and Time Priority, are Ranked with the Highest Price at the Top, While Sell Orders are Ranked with the Lowest Price at the Top.

The figure 1 describes, there are two parts in the order book: one is orders with buy choice on left side with the high price at the top, and lowest price is specified at the top on the right side with sell orders. Generally the orders are placed according to time and price priority, which implies most trades organize orders in view of the best price, and, if at least two orders are embedded at a similar price, more priority is given to the first order to be inserted.

To develop an automated trading system, fund managers should have good domain knowledge of market microstructure and about various terms used in markets like stop loss, limit order, cut-off time, book value, eps, results of the company etc and how trades are executed the orders.

## TRADING PROCESS

An intuitive way to classify algorithmic buying and selling is thru the separate techniques being computerized within a trade's life cycle. As Fig 2 clarifies, algorithmic exchanging can be utilized at any phase of the exchanging procedure and for different commitment, including macro-trading market making, arbitrage, and spread trading. Automated trading therefore covers a wide variety of systems. In trade-execution programs, for example, the algorithm might decide aspects such as price, timing, and order's quantity splits. Other systems might automate the complete trading process.



**Figure 2: Algorithmic Trading Systems** the figure shows the three stages of algorithmic Trading Pretrade Analysis, Trading Signal, and Trade Execution and the Two Major Firm Types: Agency Execution and Principal Trading

As the “Algorithmic Trading System Components” sidebar describes, the trading process can be split into four stylized steps: pretrade analysis, trading signal generation, trade execution, and post-trade analysis.

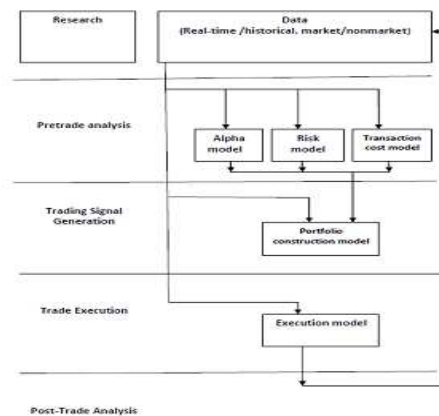
## ALGORITHMIC TRADING SYSTEM COMPONENTS

Figure 2. a shows the major components of an algorithmic trading system and the steps at which they occur.

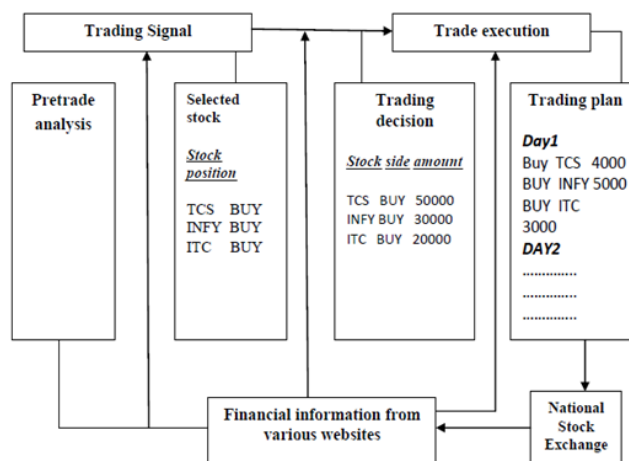
First step in algorithm trading is Pretrade analysis it includes three mathematical models: the popular model transaction cost model calculates the costs associated with trading the financial instruments. And second model is the risk model identifies the levels of risk associated with financial instruments and third model is the alpha model predicts the behaviour of the financial instruments to trade.

Portfolio construction model receives the results of alpha, risk, transaction cost models as its inputs and then trading signal generated.

The execution model executes the trades, making several decisions with constraints on (actual) transaction costs and trading duration this process is done at trade execution. General decision is the trading strategy followed by the order type and venue type.



**Figure 2: Steps at which the Algorithmic Trading System Components Occur**



**Figure 3: Example Algorithmic Trading System the Pretrade Analysis Selects a Group of Stocks to Buy and Passes this Information to the Trading Signal Component, Which Determines the Quantity of Each Stock to Buy. Finally the Trade Execution Determines the Trading Plan By selecting the Exchanges and Associated Quantities**

In trading environment Pretrade analysis is the most frequent algorithm. The pretrade analysis system uses financial news or article news or twitter news to analyze certain properties of an asset. It can be as easy as a approach to price a company, or it can involve modern algorithms that use machine learning algorithms to scan news or Twitter feeds to forecast asset price volatility. Pretrade analysis, as a stand-alone algorithmic trading system, stops short of producing a trade signal. Human traders utilize the yield to settle trading decisions that are based on a selection of trading signals and some optional information.

Trading signal generation is next step in automated trading process. Efficient trading institutions and company asset managers use this level of automation. Human traders can execute the generated signal.

Trade order execution is the third step in automated trading, it places orders and execute orders in one or more trade exchanges. Trade order execution is depending on various factors like costs, order size, client type, speed of execution, and nature of order etc. If a human trader put his order on limit type the risk is less compare to market order in this case the algorithm only optimizes the execution.

### **ALGORITHMIC TRADING SYSTEM EXAMPLE**

We demonstrate the automated trading systems operation; we tend to use an easy example of a fully automated system for the equity market specifically, from the NSE (National Stock Exchange). During this example the challenge is to copy the NSE by trading a subset of shares that gives a similar performance to the index where as minimizing the transactions charges naturally incurred once rebalancing any replicating portfolio.

The pretrade analysis framework estimate and variation the historical performances of several index-tracking strategies to help the user select the strategy that best suits present market situations. Remaining components work toward imposing the chosen replicating strategy. Particularly, the trading signal component selects the shares for constructing the benchmark portfolio and determines the weight of each share price in the portfolio.

The trade execution components identify best strategy for getting returns, by minimizing timing risk and market impact. The figure3 represent the strategies in trading signal generation and trade execution is formulated as an optimization problem with multi-objective constraints. Various algorithms are used to solve these problems, like genetic programming, quadratic programming etc.

### **PRETRADE ANALYSIS**

The purpose of pretrade analysis is to identify the forecasting future pattern and generating the trading signals by analyzing financial data or news when trading opportunity occurs in the stock markets. There are three types of analysis is used to predict future outcome in stock markets those are technical analysis, fundamental analysis and quantitative analysis.

#### **Fundamental Analysis**

Fundamental Analysis is the study of information that affects the assets prices. Its aim is to determine the assets future price movements. The information here may include unemployment figures, interest rates, gross domestic product or national policies of countries. In the recent years, traders and analysts are using advanced mathematics and statistical models from various fields like computational statistics and machine learning to determine the relationships between the fundamental quantities and stock price's future value.

## Technical Analysis

Technical Analysis is a technique which uses historical data of company to predict future stock price. Technical analysis finds to discover hidden patterns of price movement. Moving average, advance-decline lines and ratios, the relative strength index, and the stochastic oscillator are some of the indicators used by technical traders for indicating market momentum. Generally, technical analysis techniques are based on the price movements in trends. So, trading systems generally generate entry signals, when a new trend is identified and generate exit signals when a trend ends. They traditionally determine trends by analyzing the continuation patterns and reversal patterns, trend lines, support and resistance areas.

## Quantitative Analysis

Quantitative analysis is related to pricing of derivative products, whose fair value depends on the stochastic property and the analysis of the temporal convergence and divergence of price movements assets. It treats assets prices as random and uses mathematical and statistical models to find a new model for its randomness. Quantitative analysis focuses on stochastic behavior of stock prices. That is why they are dominating the financial industry by forming a solid foundation.

## TRADING SIGNAL GENERATION

The real distinction between pretrade analysis and trading signal generation is that a actual signal produced by a algorithmic trading will accompany a particular price and may even incorporate risk management recommendations, such as specific stop-loss values where as pretrade analysis specifies recommendations whether to buy or sell of particular share of the company and the trading signal must be able to correctly analyze diverse trading environments, such as the volatile few minutes following an important economic data release or quiet and illiquid market times during Asian trading hours.

## Entry Strategies

Entry strategies are very important in automated trading, so automated trading system must generate the entry strategy, to generate a trading signal. Strategies must defined as simple as with a fixed expected returns, by using a fundamental analysis system we can identify or predict difference between the current price and the expected share value.

Sadly, there are two main deficiencies even for easy rules:

- Delayed periods increased the transactional costs
- The rule might be unable to detect the model's assumptions and a regime shift that would invalidate and the trading signal.

To avoid the deficiencies, we need to improve an entry strategy, and we need to add more complexity to the trading rules. For instance we might prefer to impose a minimum count of successive equal trade recommendations to enhance a trading signal that oscillates between opposing trades. The arrangement of conceivable extra guidelines is vast and changed; besides, the impact of impact of more than one rule can be very difficult and complex. Designing profitable entry strategies and complex strategies is nevertheless really of an art.

## Exit Strategies

Fund managers should have good knowledge on exit strategies to obtain in optimum returns, so designing an exit

strategy requires indicating when to take returns and when to exit an online trade with a minimum loss. In simple we need to stay in the market up to our assumption is valid and maximizes the returns, if the assumption is wrong immediately exited from market to reduce the losses.

In real time, this assumption is largely depends on the systems trading strategy. Lets us consider a example, a basic fundamental analysis strategy, buy shares when an current price is less than its book value until the current price or market price crosses the company's book value, this is the fundamental strategy.

Compare to fundamental trading strategy, technical analysis is give better returns because the position is open until it reaches a desired target, but sometimes we get losses if assumption is proved is wrong. Technical analysis uses stop loss rule, if prices climb above the targeted price then exit strategies will execute, by this strategy sometimes we will get losses as well as we get more profits compare to fundamental analysis.

### **Risk Management**

In trading system, it is important to calculate and manage its market exposure. It is more important than trading signals because poor risk management may easily turn the coming profits into losses. There are many methods to solve this problem. The simplest method is fixed amount system, which places an arbitrary fixed amount in every trade. But the problem with this approach is it does not distinguish between high and low volatility.

### **Trading Signal Example**

To demonstrate trading signal generation, we utilize an exchanging signal procedure in light of alpha generation 7 for an ex-change traded fund (ETF) that can be exchanged on trade like standard stock. For a trading signal method is based on alpha age, alpha is characterized as overabundance hazard balanced returns estimated over a benchmark. For this situation, the alpha generator the trading signal will decide whether a security can produce overabundance returns or returns higher than a pre selected benchmark with a controlled risk, when added to a current portfolio of advantages. Analysts utilize these signs to create scientific and measurable models that assistance decide if a particular investment may be productive.

A mean-reverting ETF system illustration accepts that the profits of every asset inside the ETF will, over the long duration, unite to the general ETF's arrival. Predetermined entry strategy rule set determines a specific level of over or under performance, we have to fallow systematic plan to sell outperforming stocks and buy under performing stocks, and so Mean Reverting assumptions are valid.

### **TRADE EXECUTION**

An algorithmic trading system builds several decisions regarding on transaction costs and trading duration, after generating the trading signal, an algorithmic trading system must make several decisions regarding constraints on transaction costs and trading duration. To execute a trade, an order should be submitted to a trading venue, with the choice depending on several factors including order size, limit price, market order and trading mechanism. If the trade is too large to execute in a single order in an open market, the system must either break it down into several smaller orders, which it submits to the market over a period of time to minimize market impact, or execute it in alternative markets such as crossing networks or dark pools that do not publicly reveal the current order book.

Whether to execute the trade immediately by submitting orders is determined by the trading system, as well as we can obtain better price by using limit order rule. We can also use stop loss order to reduce the losses.

### Trading Venues

There are many financial markets for trading. Choosing the market is left to the trader. But one thing is the traders should consider a market with high liquidity, degree of trader anonymity and different execution costs, because a highly liquid market is associated with fast trade execution and low transaction costs.

### Trading Schedules

A small order is more likely to flow under the market's radar than a large order. So, a system breaks a large order into many small orders to minimize the trade's impact on the market. Optimal trade schedule involves a desired balance between price impact and opportunity cost. There are two main steps in identifying the trading objective.

- By defining the specification of transactional cost, we need to calculate execution cost and select the desired standard price.
- We need to identify the degree of risk aversion, which indicates the level of trading aggressiveness or passiveness. Passive trading is integrated with lower market crash and higher risk whereas. Aggressive trading is integrated with higher cost and less risk. An arithmetic random walk is often the most popular model for specifying the dynamic of future market prices.

### Order Type

There are two types of trades, Market orders and limit orders. The market order provides immediate execution whereas the execution price is uncertain. In a limit order, it guarantees the execution price. The decision whether to submit a market order or limit order to execute the trade is based on the trade-off between the pay off associated with limit orders and the risk of non execution. The most important factor in valuing tradeoffs is having a model of limit order execution times and the associated execution probability, because the expected profit of traders who decide to trade using limit orders is an increasing function of the execution probability.

### Trade Execution Example

The main objective of trade execution system is to minimize the hidden costs by balancing the trade-off between market impact and timing risk over the trading horizon. The necessary transparency and flexibility is provided by the system to develop a customized algorithmic strategy to ensure that the algorithmic parameters are consistent with the overall investment goal. Investors must specify the benchmark to use the system. It can be trading style and preferred adaptation tactic. This tactic describes how they want the algorithm to adapt to changing market conditions.

## CONCLUSIONS

Algorithmic buying and selling would possibly be described as an arms race drawing on the competencies of top computing professionals. Traditionally, funding banks and fund managers employed economists for buying and selling positions and computing authorities for science posts. Now, given the increasing importance of algorithmic buying and selling in monetary markets, firms are searching for trader-programmers skilled in C-based languages and analytics (such as computational data and laptop learning). For computing experts fascinated in finance, it is a stimulating and truly well-



paid career.

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